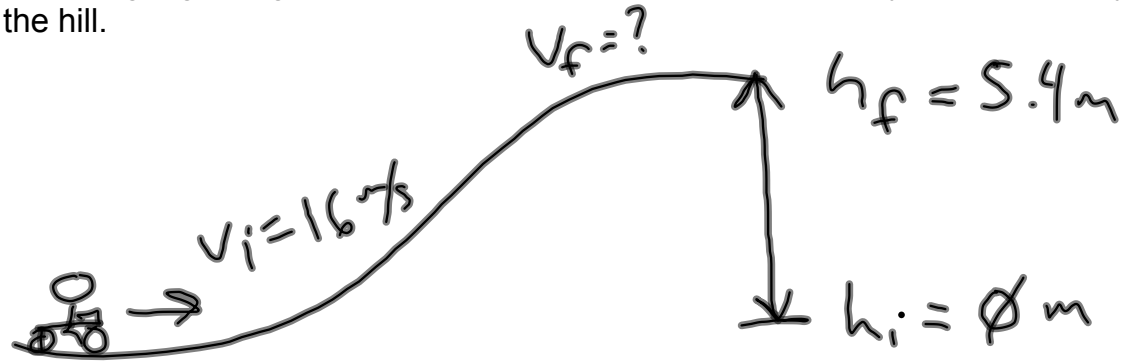
Practice Problems 4.20.12 Honors Physics

A cyclist approaches the bottom of a gradual hill at a velocity of 16 m/s. The hill is 5.4 m high, and the cyclist estimates that she is going fast enough to coast up and over it without peddling. Ignoring air resistance and friction, find the velocity at which the cyclist crests the hill.



$$E_i = E_f$$

$$K_i + U_{gi} = K_f + U_{gf}$$

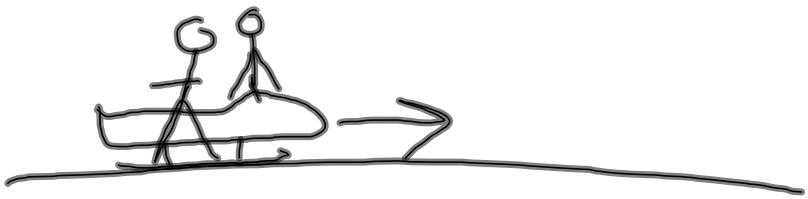
$$\frac{1}{2}v_i^2 = \frac{1}{2}v_f^2 + a_g h_f$$

$$v_f = \sqrt{v_i^2 - 2a_g h_f}$$

$$= 12.25\ m/s$$

Practice Problems 4.20.12 Honors Physics

A 75 kg bobsled is pushed along a horizontal surface by two athletes. After the bobsled is pushed a distance of 4.5 m starting from rest, its speed is 6.0 m/s. Find the magnitude of the net force on the bobsled.



$$W = \Delta E$$

$$F d \cancel{\cos\theta^{1}} = (K_f - \cancel{K_i}^{0}) + (\cancel{U_{gf}}^{0} - U_{gi})$$

$$F d = \frac{1}{2} m v_f^2$$

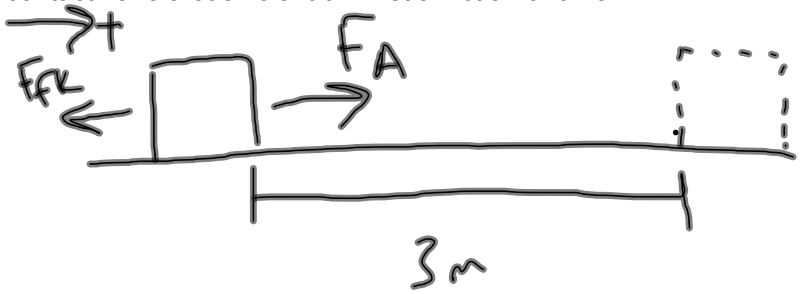
$$F = \frac{m v_f^2}{2d}$$

$$= \frac{(75\ kg)(6\ m/s)^2}{2(4.5\ m)}$$

$$= 300\ N$$

Practice Problems 4.20.12 Honors Physics

A 6.0 kg block initially at rest is pulled to the right along a horizontal surface by a constant horizontal force of 12 N. Find the speed of the block after it has moved 3.0 m if the surfaces in contact have a coefficient of kinetic friction of 0.15.



$$W = \Delta E$$

$$F_{net}\, d \cancel{\cos\theta^{1}} = (K_f - K_i)^{0} + \cancel{(U_{gf} - U_{gi})^{0}}$$

$$(F_A - F_{fk})\, d = \frac{1}{2} m v_f^2$$

$$v_f = \sqrt{\frac{2}{m}\left[(F_A - F_{fk})\, d\right]}$$

$$F_{fk} = \mu_k F_N$$

$$= \mu_k m a_g$$

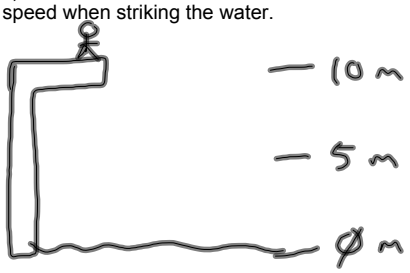
$$= \sqrt{\frac{2}{(6\,kg)}\left[(12\,N - 8.82\,N)(3\,m)\right]}$$

$$= 8.82\,N$$

$$= 1.78\ m/s$$

Practice Problems 4.20.12 Honors Physics

a) A 755 N diver drops from a board 10 m above the water's surface. Find the diver's speed 5 m above the water's surface.
b) Find the diver's speed just before striking the water.
c). If the diver leaves the board with an initial upward speed of 2 m/s, find the diver's speed when striking the water.



Conservation of energy

a) $v_i = 0$ m/s $\quad h_i = 10$ m $\quad h_f = 5$ m

* can change to 5 m and 0 m if you want to

$$\frac{1}{2}\cancel{v_i^2}^{0} + a_g h_i = \frac{1}{2}v_f^2 + a_g h_f$$

$$v_f = \sqrt{2a_g(h_i - h_f)}$$

$$= 9.89 \text{ m/s}$$

b) $v_f = \sqrt{2a_g(h_i - h_f)}$ $\quad h_i = 10$ m, $h_f = 0$ m

$$= 14.0 \text{ m/s}$$

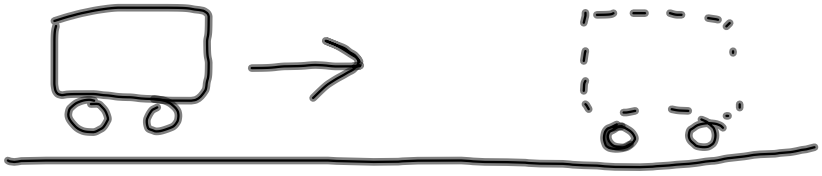
c) $v_i = 2$ m/s $\quad h_i = 10$ m $\quad h_f = 0$ m

$$v_f = \sqrt{v_i^2 + 2a_g h_i}$$

$$= 14.14 \text{ m/s}$$

Practice Problems 4.20.12 Honors Physics

A 1500 kg car accelerates uniformly from rest to 10 m/s in 3 s.
a) What is the work done on the car in this time interval?
b) What is the power delivered by the engine in this time interval?



A) $W = \Delta E$

$= (K_f - K_i) + (U_{gf} - U_{gi})$

$= \frac{1}{2} m v_f^2$

$= 75000 \text{ J}$

B) $P = \frac{W}{t}$

$= 25000 \text{ W}$